

**REMARKS/ARGUMENTS**

Claims 4-6, 16 and 17 have been cancelled without prejudice or disclaimer. Claim 7 has been amended. Claims 7-15 are currently pending in this application.

Claim 7 has been amended to indicate that the measured analine point ranges from 110°F to 170°F. Support for this amendment may be found on page 15, line 24 to page 16, line 4. Furthermore, claim 7 has been amended to define the VGO as having a measured analine point that is lower than a calculated analine point. Support for this amendment may be found for example on page 15, lines 10-13, and Tables 17A –17C, pages 49-53.

**Rejection Under 35 U.S.C. 112**

Claims 7-15 have been rejected under 35 U.S.C. 112, first paragraph. Examiner indicated that the range of the measured analine point from 110° to 150°F as defined in claim 7 was not supported by the specification at the time of filing. As stated in the last response, this range is supported in the application with reference to Table 15 on page 47, where Analine points throughout this range are disclosed. However, Applicant has further amended the range of the measured analine point to read from about 110° to about 170°F. Support for this amendment may be found on page 15, line 24 to page 16, line 4.

Removal of the rejection to claims 7-15 under 35 U.S.C. 112, first paragraph is requested.

**Rejection Under 35 U.S.C. 103(a)**

Examiner has rejected claims 7-15 under 35 U.S.C. 103(a) as being unpatentable over Freel et al. (U.S. Patent No. 5,792,340) in view of Chomyn (U.S. Patent No. 5,858,213) or Mosby et al. (U.S. Patent No. 5,626,741). Applicant respectfully disagrees with this rejection.

Claim 7 defines a method of producing a VGO by processing a heavy hydrocarbon feedstock in the presence of a particulate heat carrier from about 300° to about 700°C, collecting the product stream, and isolating the VGO. Applicant submits that when considered as a whole, the claimed method is not obvious in view of the cited prior art as the combination of features defined in the claim are not suggested within Chomyn, Mosby and Freel when considered alone, or in combination. Applicant also submits that the methods disclosed in either Chomyn or Mosby would not be relied upon by one of skill in the art to combine with the method of Freel as the methods of Chomyn or Mosby involve very different procedures than that of Freel: distillation in the absence of a particulate heat carrier (Chomyn or Mosby) v. pyrolysis in the presence of a particulate heat carrier (Freel). Furthermore, it is submitted that even though VGOs are known, novel methods for the production of a VGO are patentable, and the present invention describes such novel methods. These points are argued in more detail below.

Examiner is relying on Freel as disclosing a process for cracking a heavy hydrocarbon feedstock (page 3 of the Action) in a process that is similar to that being presently claimed. Examiner acknowledges that Freel does not disclose the isolation of a VGO from the liquid product, and relies upon Chomyn and Mosby for the process of isolating a VGO from a heavy hydrocarbon feedstock. Examiner states on page 4 of the Office Action that “[i]t would have been obvious to one having ordinary skill in the art at the time the invention was made to have

modified the process of Freel by separating VGO from the liquid product as taught by either Chomyn or Mosby, because such a step is capable of separating the product into more valuable product such as distillates and VGO.” Applicant submits that this conclusion is incorrect and over simplifies the merits of the present invention.

Freel discloses a process to pyrolyze a carbonaceous feedstock, and a heavy hydrocarbon is listed as a type of carbonaceous feedstock that may be processed. However, no products were further processed in Freel, nor is there any suggestion that a pyrolysis product, irrespective of the feedstock used, may be further processed. There is also no teaching or suggestion in Freel, that a pyrolysis product produced using a heavy hydrocarbon feedstock may be further processed to produce a VGO fraction as defined in claim 7. Furthermore, properties of a VGO produced by this method were not disclosed or suggested. Clearly, one of skill in the art upon reading Freel would not have been lead to isolate any fraction for a product produced following rapid thermal pyrolysis, let alone a VGO fraction.

In Mosby, a process for processing a heavy hydrocarbon feedstock is described that involves passing a heated feedstock to a primary distillation tower (26, Figure 3) where volatiles (29-32), atmospheric gas (33), and a crude fraction (35) are obtained (see col 4, line 55 to col 5, line 44). The Atmospheric gas is sent to a fluid catalytic cracking unit (FCCU; Figure 1) for further processing, and the crude fraction is heated and either sent to an FCCU, or to a pipestill vacuum tower (42) for processing. If the crude fraction is sent to a pipestill vacuum tower, further fractionation occurs in the presence of steam to produce a wet gas (46), a heavy or light vaccum gas oil (48), and a crude fraction (50). The heavy or light vaccum gas oil, and the crude fraction may be further processed, for example using an FCC unit.

The process described in Mosby to produce a VGO is very different from that described in the present invention. The VGO in Mosby is obtained from a crude fraction of a heavy hydrocarbon feedstock that has been pretreated by passing through a primary distillation tower to remove volatiles and water gas, followed by fractionation within a pipestill vacuum tower. The feedstock has not been in contact with a particulate heat carrier, or upgraded in any manner as described in the present invention.

In Chomyn, a feedstock is mixed with steam and this mixture is introduced into the flash zone of a distillation tower (see col 2, line 55 to col 3, line 5). A VGO (28, 29, 31, Figure 1) is isolated from distillation of the heavy hydrocarbon feedstock and used for further processing. The VGO so produced is a distillation product. However, the feedstock has not been in contact with a particulate heat carrier, or upgraded in any manner as described in the present invention prior to the isolation of the VGO fraction.

In both Mosby and Choymn, the VGO fraction is further processed within an upflow reactor comprising a particulate heat carrier, for example a fluid catalytic cracking unit. The processing of the VGO with a particulate heat carrier occurs *after* the VGO fraction has been obtained by distillation. In the present invention, the feedstock is processed using a particulate heat carrier *before* isolation of a VGO fraction. Clearly, the method of the present invention is very different from that disclosed in either Choymn or Mosby.

Furthermore the VGO produced using the present invention exhibits unique properties. A comparison of prior art VGOs and the VGOs of the present invention is provided on page 14, line 22 to page 15, line 23, and page 54, lines 3-11 of the specification. The properties of the VGO of the present invention are different from those of the prior art for example, the calculated

aniline point of a VGO of the present invention is higher than the measured aniline point of the same VGO, while for prior art VGOs, the calculated aniline point correlates well with the cracking characteristics of the VGO. As explained in the identified passages of text, this difference may be due to the unique hydrocarbon profile of the VGO of the present invention that comprises a high proportion of mono-aromatic plus thiophene aromatic compounds.

The unique properties of the VGO fractions produced according to the method of the present invention were highlighted by an independent third party (see in Appendix A the report from Dennis Kowalczyk of "Refining Process Services, Inc." The dates and fax headers have been redacted from this document.). The data from this report was used in Example 6, page 46, of the present invention. In this report, in the last paragraph on page 2, it is stated that

"[c]onversion differences for the three ... feedstocks relative to the ANS VGO was larger than anticipated based on comparison with the MAT testing results."

On page 3, top paragraph, line 6, it is noted that

"...we estimated that the aniline point for the Athabasca, Kerrobert and hydrotreated Athabasca material would be closer to 135°F, 144°F and 168°F, respectively. Aniline points for these feeds were measured at 110°F, 119°F and 133°F, respectively."

Furthermore, on page 3, third paragraph it is stated that:

"in our initial meeting...it was reported that the upgraded feedstocks should crack to a greater extent than would be apparent by examining the physical inspections. This appears to be the case. The hydrocarbon composition data...indicates that the upgraded feeds contain close to 38% mono-aromatics plus thiophene aromatics. These

types of molecules have significant amounts of side chains available for cracking and therefore provide higher levels of conversion and light liquid product.”

This report clearly identifies that the VGOs produced according to the methods of the present invention have unique properties compared to prior art VGOs. These differences have also been highlighted within the specification on page 14, line 22 to page 15, line 23, and page 54, lines 3-11, as noted above. Even though Mosby and Chomyn disclose isolation of a VGO fraction, prior art VGOs as suggested within the attached report exhibit different properties than the VGOs of the present invention.

Mosby or Chomyn are examples of obtaining a VGO fraction from a heavy hydrocarbon feedstock. The fact that a VGO fraction can be obtained, and that it can be further processed within an FCC unit does not mean that alternate methods to produce a VGO fraction are obvious, nor does it mean that all VGO fractions are the same. To suggest that a VGO fraction obtained from a pipestill vacuum tower, or a distillation tower, renders the present invention obvious, is a gross over simplification of the processes disclosed in the present invention. Applicant submits that hindsight analysis of the present invention is required for such a conclusion to be reached. Such hindsight reasoning is permitted only if it takes into account knowledge which was within the level of ordinary skill in the art at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure (In re McLaughlin 443 F.2d 1392, 1395, 170 USPQ 209, 212 (CCPA 1971)).

There is no teaching or suggestion within Mosby or Chomyn that a VGO may be obtained from a product obtained following rapid thermal processing of a heavy hydrocarbon feedstock in the presence of a particulate heat carrier. Rather, prior to the present invention, the

use of particulate heat carriers was typically directed to cracking feedstocks for example within FCC units (as described by either Chomyn or Mosby). It was not generally known that a particulate heat carrier could be used to mildly crack and upgrade the feedstock as described in the present application and that a VGO fraction with useful properties could then be obtained. Similarly, there is no teaching or suggestion in Freel that a VGO fraction could be derived from a product obtained following rapid thermal processing, nor was there any suggestion as to what the properties of the product would be following this treatment.

Examiner states on page 5 of the Office Action that Chomyn and Mosby were relied upon to teach that it is known to separate VGO from a hydrocarbon stream, and a hydrocarbon stream is produced using the Freel process.

However, by making this suggestion, Examiner is ignoring the claim as a whole. Claim 7 is directed to a combination of elements, and the combination of elements needs to be considered in view of the prior art. When the claim as a whole is considered, it can readily be seen that Chomyn and Mosby do not teach or suggest thermal processing of a heavy hydrocarbon feedstock in the presence of a particulate heat carrier, and Freel does not teach or suggest the further processing of a product obtained from thermal processing of a feedstock, let alone obtaining a VGO fraction. One of skill in the art would not have been lead to combine these methods due to the differences in the methods used, and due to the lack of suggestion in any of the documents to combine any of the steps.

Examiner goes on to suggest (on page 5) that a product stream of Freel would comprise the VGO fraction of the present invention. However, this is irrelevant with respect to the present invention because: 1) a VGO was not isolated or characterized in any manner in Freel; 2) there

was no suggestion in Freel that such a fraction could be obtained; and 3) the existence of a fraction within a product does not automatically make the isolated fraction unpatentable. If Examiner's logic is followed with reference to an alternate example, then an antibiotic obtained from a bacteria, or from an extract obtained from the bacteria, would not be patentable, since the bacteria "would comprise [an antibiotic] having the same properties as the [antibiotic] from the claimed process." Even though an antibiotic is a desired product, antibiotics and their methods of production are well known to be patentable, as are alternate methods for their production. Just because a product is known does not mean that alternate methods for its production are not patentable.

Furthermore, in the present case, Applicant submits that not only is the method novel, but the product produced by the method is novel and exhibits unexpectedly different properties from VGOs of the prior art. Neither Freel, Mosby, nor Chomyn provide any motivation to isolate the specific VGO fraction having the claimed properties.

Applicant submits that Freel et al., Mosby et al. and Chomyn, either alone or in combination, do not teach or suggest the combination of features as defined in claim 7, and that one of skill in the art, upon reading Freel et al., Mosby et al. and Chomyn would not have been lead to the invention as claimed in claim 7. As claims 8-15 each depend from claim 7, they include the claims limitations of claim 7, and are allowable for at least the same reasons.



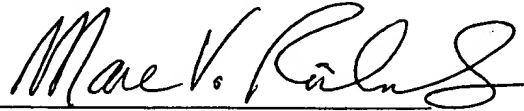
Application No. 09/955,267

Amendment and Response under 37 C.F.R. 1.116 Faxed August 29, 2005

Reply to Office Action of May 27, 2005

Removal of the rejection to claims 7-15, under 35 U.S.C. 103(a) is respectfully requested.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Marc V. Richards".

Marc V. Richards

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Amendment and Response under 37 C.F.R. 1.116 Faxed August 29, 2005

Reply to Office Action of May 27, 2005

## **Appendix A**

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## Refining

Process Services

Mr. Rob Kromm  
Purvin & Gertz, Inc.  
Suite 1720, 144 - 4<sup>th</sup> Avenue  
Calgary, Alberta T2P 3N4  
Canada

Dear Rob:

Please find enclosed the results of the Ensyn feedstock study. The materials used for this study are described in the following list of hydrocarbon feedstocks. Properties are provided in Table 1 for each of these feedstocks.

1. VGO from upgraded Athabasca bitumen (R243PL / RPS-5693)
2. VGO from upgraded Kerrobert heavy crude (R244PL / RPS-5694)
3. VGO from Alaskan North Slope (ANS) crude oil (KBR-G0254)
4. Hydrotreated VGO from Athabasca bitumen (RPS-5695)

As indicated in item 4, VGO material from the Athabasca bitumen (RPS-5693) was processed in a hydrotreating pilot plant at PARC Technical Services in Pittsburgh, Pennsylvania. The reactor conditions are listed below:

- Reactor Temperature: 720F
- Reactor Pressure: 1500 psig
- Space Velocity: 0.5
- Hydrogen Rate: 3625 SCFB

As a result of the hydrotreating, API gravity of the upgraded Athabasca material was increased from 14.2 to 22.4. At the same time, sulfur level was reduced by 92.7% from 3.7 weight % to 0.27 weight %. Chemical hydrogen consumption was measured to be about 750 SCFB. Liquid product yield was 96.4 weight % with the remainder going to hydrogen sulfide and light gases.

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### Refining Process Services - Page 2

Each of the four feedstocks was then evaluated for cracking characteristics by Microactivity (MAT) testing. The MAT testing was performed at the Kellogg Brown & Root (KBR) Technology Center. The test conditions were established by Refining Process Services and are outlined below.

Reaction Temperature: 1000F  
Run Time: 30 Seconds  
Cat-To-Oil Ratio: 4.5  
Catalyst: Equilibrium FCC Catalyst

The results of the MAT testing are presented in Table 2. The results indicate that the cracking conversion for the Athabasca, Kerrobert and Alaskan North Slope (ANS) VGO samples was approximately 63%, 66% and 73% on feed weight. The difference in MAT conversion level between ANS and the two upgraded feedstocks was less than anticipated based upon comparison of the measured aniline point numbers. The full yield structure is presented in the table for each of the feedstocks.

Table 2 also includes conversion and yield data for the hydrotreated Athabasca material. Relative to the ANS VGO, cracking conversion is higher for the hydrotreated material at 74% on feed weight. Product yields are significantly improved versus the raw Athabasca material and they are even better than for the ANS VGO.

Upon completion of the MAT testing, Refining Process Services completed stage one of a computer model study to estimate the cracking characteristics of each feedstock in a commercial FCC operation. We selected a base case for an operating FCC unit that typically cracks ANS VGO as part of a feedstock blend. In the first stage of the study, we input measured inspections including aniline point into the model. In the past, we have found that aniline point typically correlates well with cracking characteristics of a feed. Therefore, the model has been tuned to rely heavily on this factor and so it is important to provide an accurate aniline point number.

Results for stage one of the model study are presented in Tables 3 and 3A. Table 3 presents conversion and yields entirely on the basis of weight % of fresh feed. Table 3A presents conversion and yields on the basis of weight % for light gases and coke and on the basis of volume % for liquid products. The results indicate that predicted cracking conversion for the Athabasca and Kerrobert feedstocks was 21% and 16% on volume lower than for the ANS VGO. Cracking conversion for the hydrotreated Athabasca feedstock was 5% on volume lower than for the ANS VGO.

Conversion difference for the three Ensyn feedstocks relative to the ANS VGO was larger than anticipated based upon comparison with the MAT testing results. Poor cracking characteristics for the untreated feeds leads to high coke yield

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### Refining Process Services - Page 3

relative to conversion. This results in high regenerator temperature and low catalyst-to-oil ratio which further limits cracking and accelerates coke and light gas production. Therefore, we closely examined the reported aniline points for the Ensyn feedstocks. Using a procedure outlined in the appendix of this report, we estimated aniline point for each material based upon API gravity and distillation data. Based upon this procedure, we estimated that the aniline point for the Athabasca, Kerobert and hydrotreated Athabasca material would be closer to 135°F, 144°F and 168°F, respectively. Aniline points for these feeds were measured at 110°F, 119°F and 133°F, respectively.

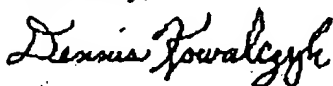
Using the calculated aniline points, we completed a second stage of the FCC model simulation study. The results for this portion of the study are presented in Tables 4 and 4A on a weight % and volume % basis, respectively. The results of the second set of model simulation runs indicate that cracking conversion would increase by 5% to 6% on volume for each Ensyn feedstock while the ANS VGO would not change. Product yields increase accordingly and the results are now more in line with the cracking differences experienced via the MAT testing. We believe that the results presented in Tables 4 and 4A are much more realistic and should be used for feedstock valuation purposes.

In our original meeting with Ensyn, it was reported that the upgraded feedstocks should crack to a greater extent than would be apparent by examining the physical inspections. This appears to be the case. The hydrocarbon composition data developed by Core Labs indicates that the upgraded feeds contain close to 38% mono-aromatics plus thiophene aromatics. These types of molecules have significant amounts of side chains available for cracking and therefore provide higher levels of conversion and light liquid product.

At the bottom of each table are the value differentials between ANS VGO and the three Ensyn feedstocks based upon FCC product value. The basis for this calculation is a set of recent product values for the U.S. Gulf Coast.

After you have had a chance to review the results of this analysis, please call if you have questions or would like to discuss the results in more detail. We have enjoyed the opportunity to work with you on this assignment and hope that we might work together in the future.

Sincerely,



Dennis Kowalczyk  
Refining Process Services, Inc.

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**Table 1**  
**Ensyn Feed Study**

	Athabasca Upgrade	Kerobert Upgrade	Alaskan North Slope VGO	Hydrotreated Athabasca Upgrade
ID	R243PL	R244PL	KBR-G0254	NA
RPS No.	5693	6894	NA	5695
API Gravity	13.8	15.5	21.7	22.4
Sulfur, Wt%	3.93	3.06	1.1	0.27
Distillation Type: °F	D1160	D1160	D1160	D2887
IBP	619	639	469	246
5%	660	664	615	476
10%	671	672	664	546
20%	684	688	718	609
30%	696	701	750	641
40%	716	722	786	665
50%	742	751	811	690
60%	763	787	833	725
70%	821	821	864	767
80%	860	855	895	811
90%	902	893	934	866
95%	937	920	973	910
EP	965	961	1032	1005
Aniline Point: °F	110	119	168	133.4
Total Nitrogen, ppm	2392	1617	1500	1100
Basic Nitrogen, ppm	859	489	418	NA
Nickel: ppm	NA	NA	1	NA
Vanadium: ppm	NA	NA	0.7	NA
Carbon Residue, Wt%	0.6	0.4	0.38	NA

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**Table 2**  
**MAT Testing Results**

<b>KBRTC MAT Comparison</b>				
Run Number	811	812	815	814
Date	04/24/2000	04/24/2000	04/27/2000	04/24/2000
Catalyst Number	G-0382	G-0382	G-0382	G-0382
Oil Feed Number	RPS-5693	RPS-5694	KBR-G-0264	RPS-5695
Co. Supplying Feedstock	RPS-5693	RPS	KBR	RPS
Special Features	0	0	0	0
Catalyst Charge (grams)	4.5054	4.5061	4.5064	4.5056
Feed Charge (grams)	1.0694	1.0553	1.0188	1
Catalyst/Oil Ratio	4.2	4.3	4.4	4.5
Preheat Temperature (°F)	1015	1015	1015	1015
Bed Temperature (°F)	1000	1000	1000	1000
Oil Inject Time (sec)	30	30	30	30
Conversion (Wt%)	62.75%	65.92%	73.02%	74.08%
Normalized Wt%				
H <sub>2</sub> S	2.22%	1.90%	0.79%	0.13%
H <sub>2</sub>	0.19%	0.18%	0.17%	0.24%
CH <sub>4</sub>	1.44%	1.33%	1.12%	1.07%
C <sub>2</sub> H <sub>2</sub>	0.00%	0.00%	0.00%	0.00%
C <sub>2</sub> H <sub>4</sub>	1.01%	1.05%	0.97%	0.93%
C <sub>2</sub> H <sub>6</sub>	1.03%	0.94%	0.76%	0.66%
C <sub>3</sub> H <sub>4</sub>	0.00%	0.00%	0.00%	0.00%
C <sub>3</sub> H <sub>6</sub>	4.11%	4.39%	5.15%	4.55%
C <sub>3</sub> H <sub>8</sub>	1.01%	1.06%	1.16%	1.01%
C <sub>4</sub> H <sub>6</sub>	0.00%	0.00%	0.00%	0.00%
1-C <sub>4</sub> H <sub>8</sub>	0.80%	1.02%	1.19%	1.09%
1-C <sub>4</sub> H <sub>8</sub>	0.96%	0.92%	1.05%	0.83%
c-2-C <sub>4</sub> H <sub>8</sub>	0.69%	0.81%	0.97%	0.80%
t-2-C <sub>4</sub> H <sub>8</sub>	0.98%	1.13%	1.36%	1.14%
1-C <sub>4</sub> H <sub>10</sub>	2.58%	3.20%	4.31%	4.59%
N-C <sub>4</sub> H <sub>10</sub>	0.38%	0.50%	0.65%	0.63%
C5 - 430°F	39.53%	42.35%	49.10%	52.67%
430°F - 650°F	23.29%	22.30%	18.75%	18.92%
650°F - 800°F	10.71%	9.03%	6.06%	5.27%
800°F +	3.24%	2.75%	2.17%	1.74%
Coke	5.73%	5.13%	4.28%	3.73%
Material Balance	97.93%	98.03%	96.59%	97.10%

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Table 3  
Measured Aniline Point - Wt% Results

	ANS VGO Wt% FF	Athabasca Wt% FF	HT Athabasca Wt% FF	Kerrobert Wt% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1609	1375	1662
Conversion	72.26	52.15	67.41	56.54
C <sub>1</sub> and Lighter	4.14	8.18	4.53	7.70
H <sub>2</sub> S	0.64	1.37	0.12	1.18
H <sub>2</sub>	0.18	0.21	0.22	0.25
Methane	1.35	2.87	1.65	2.65
Ethylene	1.00	1.37	1.31	1.51
Ethane	1.07	2.36	1.23	2.11
Total C <sub>2</sub>	5.29	3.81	5.65	4.41
Propylene	4.17	3.10	4.43	3.55
Propane	1.12	0.71	1.22	0.86
Total C <sub>3</sub>	8.86	5.76	8.38	6.55
Isobutane	2.59	1.47	2.97	1.81
N-Butane	0.68	0.22	0.68	0.30
Total Butenes	5.59	4.07	4.73	4.44
Gasoline (C <sub>5</sub> -430°F)	48.47	28.57	43.32	32.08
LCGO (430-650°F)	21.48	33.99	27.56	31.75
HCGO + DO (650°F+)	6.26	13.88	5.03	11.69
Coke	5.50	5.83	5.53	5.82
API Gravity	21.7	13.8	22.4	15.5
Aniline Point: °F (Measured)	168	110	133.4	119.0
Product Value: \$/BBL	Base	-3.00	-0.70	-2.23



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Table 3A  
Measured Aniline Point - Vol% Results

	ANS VGO Vol% FF	Athabasca Vol% FF	HT Athabasca Vol% FF	Kemobert Vol% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1809	1375	1552
Conversion	73.85	53.01	68.48	57.58
C <sub>2</sub> and Lighter, Wt% FF	4.13	8.19	4.53	7.70
H <sub>2</sub> S	0.54	1.37	0.12	1.18
H <sub>2</sub>	0.18	0.21	0.22	0.25
Methane	1.35	2.87	1.65	2.65
Ethylene	1.00	1.37	1.31	1.51
Ethane	1.07	2.56	1.23	2.11
Total C <sub>3</sub>	9.41	7.15	10.01	8.18
Propylene	7.37	5.79	7.81	6.64
Propane	2.04	1.35	2.20	1.64
Total C <sub>4</sub>	13.79	9.35	13.05	11.57
Isobutane	4.25	2.40	4.85	3.21
N-Butane	1.08	0.35	1.07	0.53
Total Butenes	8.48	6.60	7.13	7.83
Gasoline (C <sub>5</sub> -430°F)	58.46	35.35	51.59	39.49
LCGO (430-650°F)	20.78	34.74	27.08	32.06
HCGO + DO (650°F+)	5.37	12.25	4.44	10.38
Coke, Wt% FF	5.50	5.83	5.53	5.82
API Gravity	21.7	13.8	22.4	15.5
Aniline Point: °F (Measured)	168	110	133.4	119.0
Product Value: \$/BBL	Base	-3.00	-0.70	-2.23

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Table 4  
Calculated Aniline Point - Wt% Results

	ANS VGO Wt% FF	Athabasca Wt% FF	HT Athabasca Wt% FF	Kerrobert Wt% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1464	1272	1383
Conversion	72.26	55.25	72.67	60.79
C <sub>2</sub> and Lighter	4.14	6.78	3.53	6.04
H <sub>2</sub> S	0.54	1.40	0.13	1.25
H <sub>2</sub>	0.18	0.17	0.18	0.18
Methane	1.35	2.14	1.21	1.86
Ethylene	1.00	1.19	1.07	1.20
Ethane	1.07	1.89	0.94	1.57
Total C <sub>3</sub>	5.29	3.91	5.71	4.48
Propylene	4.17	3.18	4.60	3.57
Propane	1.12	0.73	1.11	0.89
Total C <sub>4</sub>	8.86	6.63	9.83	7.64
Isobutane	2.59	1.70	3.07	2.09
N-Butane	0.68	0.25	0.75	0.33
Total Butenes	5.59	4.68	6.01	5.12
Gasoline (C <sub>6</sub> -430°F)	48.47	32.38	48.27	37.29
LCGO (430-650°F)	21.48	31.09	23.19	28.28
HCGO + DO (850°F+)	8.28	13.66	4.14	10.93
Coke	5.50	5.56	5.33	5.46
API Gravity (Feed)	21.7	13.8	22.4	15.5
Aniline Point: °F (Calc.)	168	135.0	158.0	144.0
Product Value: \$/BBL	Base	-2.50	+0.20	-1.53

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Table 4A  
Calculated Aniline Point - Vol% Results

	ANS VGO Vol% FF	Athabasca Vol% FF	HF Athabasca Vol% FF	Kerrobert Vol% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1484	1272	1383
Conversion	73.85	57.45	74.26	62.98
C <sub>2</sub> and Lighter, Wt% FF	4.13	6.79	3.53	6.06
H <sub>2</sub> S	0.54	1.40	0.13	1.25
H <sub>2</sub>	0.18	0.17	0.18	0.16
Methane	1.35	2.14	1.21	1.86
Ethylene	1.00	1.19	1.07	1.20
Ethane	1.07	1.89	0.94	1.57
Total C <sub>3</sub>	9.41	7.33	10.10	8.27
Propylene	7.37	5.93	8.10	6.59
Propane	2.04	1.40	2.00	1.68
Total C <sub>4</sub>	13.79	10.76	15.26	12.18
Isobutane	4.25	2.75	5.01	3.37
N-Butane	1.08	0.41	1.18	0.54
Total Butenes	8.46	7.60	9.07	8.27
Gasoline (C <sub>5</sub> -430°F)	58.46	39.71	57.07	45.57
LCGO (430-650°F)	20.78	30.85	22.20	27.70
HCGO + DO (650°F+)	5.37	11.70	3.55	9.32
Coke, Wt% FF	5.50	5.56	5.33	5.46
API Gravity (Feed)	21.7	13.8	22.4	15.5
Aniline Point: °F (Calc.)	168	135.0	158.0	144.0
Product Value: \$/BBL	Base	-2.50	+0.20	-2.23

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**APPENDIX**

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## APPROXIMATE PROPERTIES OF PETROLEUM FRACTIONS

WINN PET. REF. 38 188 (1957)

